Task 1.2 Final Report

# Goals, Potential Impacts, Performance Measures and Methodology for Comparative Evaluation

## For the Project Entitled

# Dairy Best Available Technologies in the Okeechobee Basin

### SFWMD Contract No. C-11652

**Submitted By**

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# Goals, Potential Impacts, Performance Measures and Methodology for Comparative Evaluation of Best Available Dairy Technologies in the Okeechobee Basin

## Executive Summary

The purpose of the Dairy Best Available Technology project is to identify, select, monitor, and oversee the implementation of best available technologies (BATs) that will significantly reduce the export of phosphorus (P) from dairy operations into Lake Okeechobee and its tributaries. The project goal statement provides a clear and unambiguous target for success:

> *This project will result in the unbiased identification, selection, implementation, and monitoring of Best Available Technologies (BATs) that will significantly reduce P export from dairy operations into Lake Okeechobee and its tributaries and bring about the most substantial improvements in water quality in the shortest amount of time possible, while minimizing project costs and detrimental socio-economic impacts to the local region.*

The selection of the best available technologies is being implemented through a decision-making process called value modeling. The value model provides a logical process to rank technologies.

A value model was developed from the goal statement for the project. The model describes the set of objectives necessary to achieve the goals in the goal statement and measurable criteria for each objective. The five objectives for the Best Available Dairy Technologies Project are to:

- Maximize Engineering Feasibility
- Maximize Cost-Effectiveness
- Maximize Water Quality Benefit
- Maximize Ease of Implementation
- Minimize Environmental and Socio-Economic Impacts

Performance criteria for each objective were then defined. While the performance of a technology with respect to a criterion may be measured quantitatively or qualitatively a single common scale was developed to standardize all criteria measurements.

The standardized nature of criteria scales is balanced by criteria weighting. Weighting is a cooperative, consensus process to be conducted by the Technical Review Team (TRT), stakeholders, and possibly others. The group will collectively identify the relative

importance of each objective and each criterion within an objective, and weight the criteria based on that importance.

As technologies are evaluated they will be scored for their performance with respect to each criterion within each objective. By weighting the score that each technology receives on each criterion the relative importance of the performance of each technology will be fully defined within the value matrix. The total weighted score of each technology will then be calculated and the technologies can be ranked.

# Introduction

The purpose of the Dairy Best Available Technology project is to identify, select, monitor, and oversee the implementation of best available technologies (BATs) than will significantly reduce the export of phosphorus (P) from dairy operations into Lake Okeechobee and its tributaries. This document describes the process that the project team will use to evaluate and select the technologies that will be installed on three selected dairies.

The dairy selection methodology, while not essential to the technology identification process, is included as an appendix to this document because the technologies actually implemented on the dairies may be partially dependent on the particular characteristics of each dairy. Therefore the dairy selection methodology is directly relevant to the larger effort. Dairies will be selected for project implementation based on:

- their willingness to participate,
- the relative amount of phosphorus being exported from the site,
- the nutrient management technologies already in place,
- the dairy technology management expertise currently available to each dairy, and
- the resources of the dairy that can be committed to ensure successful implementation of the technologies.

The technology selection process should provide a mechanism for the unbiased assessment of each technology and must be capable of considering both quantitative and qualitative evaluation criteria. For this technology assessment, the project team proposes to use a "value model" approach as described below. A value model is a weighted hierarchy of objectives, which represents the decision-makers' evaluation criteria. It is used to evaluate alternative solutions to a problem. For each major objective, a series of attributes is developed to describe how the technology can be rated in terms of achieving the objective.

# Decision Making – The Value Model

## Value Modeling

A Value Model provides a framework for defining the goals, objectives, and values expressed by District, the TRT, and other stakeholders, along with those developed independently by this project team. The Value Model is founded on the primary purpose or project goal/vision (i.e., what we are trying to achieve). Supporting the goal are the objectives, which generally represent the tangible, concrete issues or concerns most important to the District and TRT. For each objective, a single criterion or series of criteria (performance metrics) are developed to measure how well each objective accomplishes the primary goal.

This approach provides a basis for modeling the value judgements and evaluation criteria, which decision makers will use to evaluate and prioritize different alternatives. The alternatives will then be developed and evaluated in a way that is consistent with the relevant value judgements and information gathered about each alternative. The benefits of this process are numerous:

- It aids decision makers in articulating objectives and values and how to make tradeoffs between these objectives
- It can evaluate and prioritize different types of alternatives using multiple and possibly competing objectives.
- It guides identification of alternatives.
- It thoroughly examines the implication of selecting specific alternatives.
- It can explicitly address uncertainty and give decision makers insights in to the impacts of these uncertainties on the selected alternatives.

The first step in the decision-making process is to develop the value model. This step requires formulation of broad-based project goals, objectives, criteria, and performance measures. Its purpose is to provide a framework for evaluating potential Dairy BAT alternatives against the identified goals, values, and objectives. After the objectives and criteria are defined performance measures are developed to provide a quantitative or qualitative means of scoring the performance of any technology for each criterion. The next step is to weight the objectives and criteria to reflect their importance to the District, the TRT, and project stakeholders. The weighting process will be conducted in an open, collaborative manner with the TRT to ensure that weighting factors are appropriately assigned.

Once the objectives and criteria are weighted and performance measures refined, a series of initial alternatives will be developed as the second part of this process. The alternatives will then be rated for the criteria with performance measures, which will be then converted to a common scale. The scale scores, when combined with the relative objective and criteria weights, create a final Value score. The Value scores allow the District to view the ranked alternatives and to develop insight into the sensitivity of the weights, scores, and associated tradeoffs between criteria. The Value scores can then be used to develop a benefit-cost analysis. Finally an uncertainty analysis, addressing the sensitivity of the constructed model to changes in the weightings for the various criteria will provide additional understanding about the influence of the various criteria on one another and potential products of the modeling process.

## Goal Statement

The project team developed a primary goal statement for this project based on information presented in the District's scope of work and our consideration and knowledge of the key issues of this project:

> *"This project will result in the unbiased identification, selection, monitoring, and implementation of Best Available Technologies (BATs) that will significantly reduce P export from dairy operations into Lake Okeechobee and its tributaries and bring about the most substantial improvements in water quality in the shortest amount of time possible, while minimizing project costs and detrimental socio-economic impacts to the local region."*

This goal statement forms the basis for developing an objective methodology to evaluate various technologies to satisfy this project goal statement.

## Objectives

As part of the original scope of services developed for this project, a number of key issues were identified to be addressed while evaluating potential technologies, as follows:

- Engineering feasibility of proposed alternatives,
- Short and long-term costs (e.g. capital, start-up, unit cost per pound of P removed, operation and maintenance) including potential revenue sources to offset project costs,
- Feasibility of each alternative relative to obtaining a water quality goal of 40 parts per billion (ppb) (Note that a numeric goal is necessary for the comparison of alternatives. A goal of 40 ppb has been selected for this project based on the most recent regulatory requirement discussions for the watershed, and to reduce the potential for harmful ecological impacts to the lake and downstream regional water resources. If this goal is not attainable, the level of P reduction that is the most technically and economically practicable will be established.),
- Impacts of an alternative on water quality and natural systems on-farm, within the nearby watershed, and the downstream lake ecosystem,
- Process start-up time and a timeline to achieve desired treatment goals,
- Socio-economic implications (i.e. economic impacts, cultural resources, social benefit/cost factors, etc.),
- Legal and regulatory issues,
- Coordination with other agencies to avoid duplication of efforts, and
- Opportunities for partnerships with the private sector.

From these major issues, the project team developed a set of objectives to further describe the primary project goal statement:

- Maximize Engineering Feasibility
- Maximize Cost-Effectiveness
- Maximize Water Quality Improvements
- Maximize Efficiency of Implementation
- Minimize Environmental and Socio-Economic Impacts

## Performance Criteria

Performance criteria are needed to provide metrics of how well the above five objectives are being met, and a sound method of quantifying them. Performance criteria define how well a given project meets the program goals and objectives. They will help to clearly indicate the preferable Dairy BAT alternatives, and to illustrate tradeoffs between competing objectives. Also, these criteria must all be structured to insure that the objectives are fundamental, independent, and as a group, comprehensive and useful in differentiating between alternatives. The range of measurement is called a scale A performance criterion can use numeric scales when a criterion is directly quantifiable, or a constructed ordinal and/or categorical scale when metrics must incorporate qualitative assessments and/or expert opinion. Two examples of performance criteria are shown in Exhibit 1. The criterion *Minimize Unit Cost of P Removed* is an example that has a numeric scale, measuring quantifiable items such as dollars. However, *Maximize Ability to Permit* is a criterion that is not easily quantifiable. For that criterion, a verbal scale is chosen based on the expectation of receiving a permit, ranging from "Never "to "Always". A qualitative scale can be translated into a relative numeric scale to assist in comparative scoring, for example from "1" (Never) to "5" (Always).

After all criteria are measured (each assigned a values on the appropriate scale) the scales must be converted to a common scale so that direct comparisons can be made. The SFWMD will be using Decision Criterium+, a software Decision Model, to perform that analysis.

**EXHIBIT 1**
Examples of Performance Criteria

| Criteria | Performance Measure | Scale |
|---|---|---|
| Minimize Unit Cost of P Removed | Estimated cost in $/lb. P removed over a set period of time. | Numeric value. Defined once alternatives are developed. |
| Maximize Ability to Obtain Permit | Expectation of receiving a permit. | "Never" to "Always" |

The Value Model for the project (Exhibit 2) is the graphic depiction of relationships between the project goal statement, the five principal objectives, and the performance criteria that have been selected to evaluate each objective. Following the graphic model are sections defining each of the objectives presented in the Value Model, describing performance criteria and sub-criteria, and associated performance measures and scales.

**EXHIBIT 2.** Value Model For Evaluation of Best Available Dairy Technologies in the Okeechobee Basin

## PROJECT GOALS:

An unbiased selection, implementation and monitoring of Best Available Technologies to:

Significantly reduce dairy industry phosphorus exports to the Okeechobee Basin and

Bring about the most effective and substantial water quality improvements in the shortest possible time.

| Objective 1 **Maximize Engineering Feasibilty** | Objective 2 **Maximize Cost-Effectiveness** | Objective 3 **Maximize Water Quality Improvements** | Objective 4 **Maximize Ease of Implementation** | Objective 5 **Minimize Environmental and Socio-Economic Impacts** |
| --- | --- | --- | --- | --- |
| Criterion 1 **Scalability** | Criterion 1 **Capital costs** | Criterion 1 **[TP] reduction** | Criterion 1 **Ease of Permitting** | Criterion 1 **Environmental Impacts** |
| Criterion 2 **Operational Reliability / flexibility** | Criterion 2 **O & M Costs** | Criterion 2 **TP Load Reduction** | Criterion 2 **Construction Time** | Criterion 2 **External Funding** |
| Criterion 3 **Impact of Disasters** | Criterion 3 **Cost per Lb P Removed** | Criterion 3 **Approach to TP = 40 PPB Target** | Criterion 3 **Startup and Training Complexity** | Criterion 3 **Basin Economic Impacts** |
| Criterion 4 **Adaptability to Existing Facilities** | | Criterion 4 **Maximize WQ Standards Compliance** | Criterion 4 **Legal and Permit Requirements** | Criterion 4 **Sidestream Benefits** |

## Objective 1: Maximize Engineering Feasibility

Maximizing engineering feasibility is essentially the alternative's ability to be engineered to meet the other performance measures, and is further defined under the following five performance criteria:

- Maximize scalability of technology
- Maximize operational reliability/flexibility
- Minimize sensitivity of technology to potential natural disasters
- Maximize adaptability to existing dairy facilities

These performance criteria are further subdivided into sub-criteria and are defined in the following sections.

### Performance Criterion: Maximize Scalability

Some technologies are easier than others to expand from pilot-scale to full-scale. This criterion attempts to identify scale-up history of a technology and assign a relative scalability factor to each technology. A score of 1 would be given to a technology for which no full scale operational system exists. A score of five would be given to a technology in full-scale operation on a dairy farm with available performance data.

**PERFORMANCE CRITERION**
Maximize Scalability

| | |
|---|---|
| Definition | This criterion relates to the scale-up history of a BAT and the relative ease with which it can be taken from pilot-scale to full-scale. |
| Performance Measure | Qualitative. Relative scalability factor assigned to each technology based upon comparison of each technology. |
| Scale | 1 to 5; higher score means better-defined scale-up of technology. |
| Assumptions | None |
| Value Functions | Positive/linear |

### Performance Criterion: Maximize Operational Reliability/Flexibility

Because a technology's operational reliability and flexibility is difficult to judge in a single step, several sub-criteria were developed to help evaluate this feature. In general, reliability can be described as the degree of assurance that the technology will meet or exceed expectations, and the degree of assurance that mechanical and process failures will occur infrequently with minimal consequences. Flexibility is a measure of how adaptable or versatile a technology may be. Several key components to reliability/flexibility include the following and are described below.

- Amount of redundancy in the system
- Familiarity with the technology
- Proven effectiveness in similar situations

## Subcriterion: Maximize Redundancy

| **SUBCRITERION**<br>Maximize Technology Process Redundancy | |
|---|---|
| Definition | Redundancy is the extent to which additional main treatment components of a system exist over and above that required for normal operating conditions. This allows a system to operate normally, for example, if it is necessary to take a unit out of service. Typically, a system is designed with a certain percentage of redundancy incorporated into it (e.g., firm capacity). This increases flexibility and therefore reliability |
| Performance Measure | Quantitative; Percentage (%) of redundancy provided by a technology. A value of 1 would be given to a technology with no redundancy. A value of 5 would be given to a technology with 100% or more redundancy. |
| Scale | Percentage 0 or higher |
| Assumptions | Professional judgement will be used to assign main treatment components to the several parts of a technology if necessary. |
| Value Function | Positive/linear |

## Subcriterion: Maximize Proven Local Effectiveness

| **SUBCRITERION**<br>Maximize Proven Local Effectiveness | |
|---|---|
| Definition | Proven effectiveness of a technology in a setting similar to that found on the dairies of the Kissimmee River Basin in terms of soils, climate, agricultural process, or other aspects of the dairy farm setting there could provide valuable information about the process and possible problems that could occur. A process that has been proven in such as setting could minimize risk and alleviate complications with such issues as permitting and training. |
| Performance Measure | Qualitative; This subcriterion is evaluated on a yes/no basis. Either the process has been used successfully in the basin (or elsewhere nearby)or it has not. |
| Scale | Yes, has been used successfully in south FL or No, has not been used |
| Assumptions | Some of the chemical treatment processes with potential application to dairies may have already been piloted in south FL. This information will be used to assign scores for this performance measure. |
| Value Function | Positive/linear |

## Performance Criterion: Minimize potential impact of natural disasters.

Another aspect of evaluating the engineering feasibility of a particular technology is its sensitivity to fire, flood, drought, and hurricane damage and its ability to re-establish a suitable treatment level following these events. The project team will collect information on the effect on treatment facilities from the previously mentioned situations, the time to re-establish design treatment conditions following such events, and the cost, if any, to re-establish design operating conditions.

**PERFORMANCE CRITERION**
Minimize Potential Impact of Natural Disasters

| | |
|---|---|
| Definition | Sensitivity of technology to fire, flood, drought, and hurricane damage and its ability to re-establish a suitable treatment level following these events. |
| Performance Measure | Qualitative; Relative numeric factor assigned to each technology based upon information gathered on each technology. A "1" would be awarded to a technology that requires a disaster-free environment for operation and needed to be completely rebuilt after a natural disaster. A technology that was insensitive to all but the most extreme natural events "5" and required no more re-establishment time than for the initial startup of the technology would receive a "5". |
| Scale | 1 to 5; higher score means less susceptibility to long-term upsets. |
| Assumptions | None |
| Value Functions | Negative/linear |

### Performance Criterion: Maximize Adaptability to Existing Dairy Facilities

The existing layout and management scheme of the selected dairies participating in this project will affect the adaptability of technologies to the unique dairy conditions. The existence of facilities on the dairies that are readily adaptable to the selected technology will receive a higher score than those that are not. The dairies selection criteria and the comprehensive nutrient management plans (CNMPs) will be used to develop a scoring approach for this criterion.

**PERFORMANCE CRITERION**
Maximize Adaptability to Existing Dairy Facilities

| | |
|---|---|
| Definition | Existing management scheme(s) of a dairy can affect the adaptability of potential treatment technologies. |
| Performance Measure | Qualitative; percentage of facilities |
| Scale | 1 to 5; Higher score means dairies with highest percent of facilities that are adaptable to potential technologies A technology that could be inserted into a dairy without additional infrastructure to connect to the existing facilities would receive a "5". A technology that required a completely new system to supply material to it would receive a "1". |
| Assumptions | Professional judgement and discussions with dairymen will provide much of the basis for the scale value a technology receives. |
| Value Functions | Positive/linear |

## Objective 2: Maximize Cost-Effectiveness

The purpose of Objective 2 is to maximize the overall cost-effectiveness of a technology. The lower the lifetime cost of a technology the more likely it is that it can be implemented cost-effectively. The four criteria characterizing this objective identify the basic components of any project cost across its lifespan, provide a way to standardize the benefit with respect to phosphorus, and recognize that the potential to develop outside funding sources is important to this objective in the long-term. The following criteria are discussed below:

- Minimize Capital Costs
- Minimize O&M Costs
- Minimize Cost per Pound of P Removed

**PERFORMANCE CRITERION**
Minimize Capital Costs

| | |
|---|---|
| Definition | Capital cost for each alternative |
| Performance Measure | Quantitative; Capital cost ($MM) |
| Scale | Dollars. |
| Assumptions | Capital costs are order of magnitude; A lower capital cost is preferred to a higher capital cost. |
| Value Function | Non-linear/linear |

**PERFORMANCE CRITERION**
Minimize Annual O&M Costs

| | |
|---|---|
| Definition | Annual O&M cost for each alternative |
| Performance Measure | Quantitative; Annual O&M cost ($MM/yr.) |
| Scale | Dollars. |
| Assumptions | O&M costs are order of magnitude; a lower annual O&M cost is preferred to a higher annual O&M cost. |
| Value Function | Negative/non-linear |

**PERFORMANCE CRITERION**
Minimize Unit Cost Per Pound of TP Removed

| | |
|---|---|
| Definition | The cost, in $/lb of TP removed for a full-scale facility sized to achieve the target concentration of 40 ppb. |
| Performance Measure | Quantitative; Equivalent annual cost (Capital + O&M – Revenue) for 50-year period/the average annual quantity of TP removed over a 10-year period $/lb TP removed |
| Scale | Dollars per pound of TP removed. |
| Assumptions | A lower unit cost is preferred to a higher unit cost. |
| Value Function | Negative/non-linear |

## Objective 3: Maximize Water Quality Improvements

The focus of Objective 3 is to evaluate technologies based on their ability to improve water quality in the Okeechobee basin, especially with regards to meeting the 40-ppb water quality goal for P. To better define this objective, four (4) performance criteria that relate directly to water quality issues were recognized:

- Maximize P Concentration Reduction
- Maximize TP Load Reduction
- Maximize Compliance with Target TP concentration (40 PPB)
- Maximize compliance with numeric Class III water quality standards

### Performance Criterion: Maximize P Concentration Reduction

Technologies will vary in their overall ability to lower the overall concentration of P in the liquid and solid materials to be treated. For this criterion, information and performance data from technical literature and existing field experiments will be used to project potential concentration reductions that will be used to aid in selecting the technology alternatives for the three cooperating dairies. Measured P concentration reductions will be used to evaluate ultimate effectiveness of the technology to meet this criterion.

**PERFORMANCE CRITERION**
Maximize TP Concentration Reduction

| | |
|---|---|
| Definition | Evaluate technologies based on their ability to reduce the total phosphorus (TP) concentration of water. |
| Performance Measure | Quantitative; TP removal efficiency is calculated using average of all TP reduction percentages from pertinent technical literature and pilot/field studies. |
| Scale | 1 to 5; higher score means higher TP concentration reduction |
| Assumptions | Average TP concentration reductions to be used in initial decision model for selection of BATs for cooperating dairies. |
| Value Functions | Positive/non-linear |

### Performance Criterion: Maximize TP Load Reduction

This criterion differs from the first criterion in that the total P load (flux) reduction will be measured instead of a reduction in TP concentration. Some technologies may be better at reducing total loads, but may fall short of other technologies in reducing the TP concentrations. This criterion will be used to evaluate differences in the two reduction strategies. For this criterion, information and performance data from technical literature and existing field experiments will be used to project potential concentration reductions to be used in the initial technology selection process for the three cooperating dairies. Measured TP load reductions will be used to evaluate ultimate effectiveness of the technology to meet this criterion.

**PERFORMANCE CRITERION**
Maximize TP Load Reduction

| | |
|---|---|
| Definition | Evaluate technologies based on their ability to maximize the removal of TP Load. |
| Performance Measure | Quantitative; TP removal data from technical literature and pilot studies will be used to measure performance for initial decision model for selection of BATs for cooperating dairies. The TP load reduction will also be compared against technology design parameters such as hydraulic detention time, depth, etc. |
| Scale | Kg P |
| Assumptions | Average projected TP load reduction over the life of the project will be used as performance measure. |
| Value Functions | Positive/non-linear |

### Performance Criterion: Maximize Compliance with Target TP concentration (40 ppb)

This criterion will assess each technology's ability to meet the 40 ppb target identified by the SFWMD in its typical performance configuration.

**PERFORMANCE CRITERION**
Maximize Compliance with Target TP concentration (40 ppb).

| | |
|---|---|
| Definition | A technology's ability to meet the 40 ppb TP standard. |
| Performance Measure | Quantitative; The final average effluent TP concentration mean and standard deviation provided by the technology under typical use conditions. |
| Scale | Mg TP/L |
| Assumptions | Literature values would be used to develop the measures for each technology. |
| Value Functions | Negative/linear |

### Performance Criterion: Maximize Compliance with numeric Class III Water Quality Standard

**PERFORMANCE CRITERION**
Maximize Compliance with numeric Class III water quality standards.

| | |
|---|---|
| Definition | A technology's ability to meet numeric standards associated with Class III Water Quality. |
| Performance Measure | Quantitative; The expected final average effluent concentration mean and standard deviation provided by the technology under typical use conditions for numeric standards.. |
| Scale | Parts per billion or parts per million as appropriate. |
| Assumptions | Literature values would be used to develop the measures for each technology. |
| Value Functions | Negative/linear |

## Objective 4: Maximize Ease of Implementation

The ability to implement a technology quickly is important to the ultimate success of this project. The ease with which a technology can be implemented is dependent on a number of factors including that amount of time required to obtain permits, construct and startup facilities, and train dairy owners on the operation and maintenance of the facilities. Also, if a technology is difficult to maintain or will cause major disruptions in the dairy's operation, it is very likely that the dairy farmer will balk at implementing the technology. To better define this objective, five (5) performance criteria were developed:

- Minimize Construction Time
- Minimize Training and Startup Time
- Maximize Familiarity with Technology
- Minimize Legal and Regulatory Requirements
- Maximize Dairy Farmer Acceptance

### Performance Criterion: Minimize Construction Time

This is one of the key criteria when trying to implement a technology in the shortest time possible. Less complex technologies typically require shorter construction times than more complex technologies. Technologies that require little or no new infrastructure would be preferable to those that require a substantial amount of new facilities.

| **PERFORMANCE CRITERION**<br>Minimize Construction Time | |
|---|---|
| Definition | Expected amount of time required to construct required facilities. |
| Performance Measure | Quantitative; Number of years, reported in quarter-years to construct alternative |
| Scale | Time – quarters of a year |
| Assumptions | None |
| Value Functions | Negative/linear |

### Performance Criterion: Minimize Training and Startup Time

- Simple technologies more familiar to a dairy farmer will require less time training and startup assistance. Many chemical treatment processes with which a farmer is unfamiliar may require more intensive training before dairy farmers are able to effectively operate the facility. Information from technical literature, operating pilot or full-scale facilities, and other sources will be used to estimate startup and training times. Thus this criterion has two subcriteria:
- Maximize familiarity of the dairymen with the technology
- Minimize training and startup time

### Subcriterion: Maximize Familiarity with Technology

| **SUBCRITERION**<br>Maximize Familiarity with Technology | |
|---|---|
| Definition | A process familiar to a dairyman will not require radically different administrative or operational procedures and will therefore require less training. |
| Performance Measure | Qualitative, Degree of familiarity with technology. A “1” would be awarded to a technology completely unfamiliar to the dairyman. A “5” would be given to a technology with which the farmer expresses complete familiarity, and that requires of the farmer no more training than a familiarization with the particular equipment installed. |
| Scale | 1-5; higher score means more familiarity with technology |
| Assumptions | Project team will collect information on technology history, performance. |
| Value Function | Positive/linear |

### Subcriterion: Minimize Training and Startup Time

| **SUBCRITERION**<br>Minimize Training and Startup Time | |
|---|---|
| Definition | Expected amount of time required to startup facilities and train staff before facility considered complete. Some technologies may have short construction periods but longer startup and training due to complexity of technology. |
| Performance Measure | Quantitative; Number of months to have technology operational after substantial completion of construction. |
| Scale | Time - months |
| Assumptions | None |
| Value Functions | Negative/linear |

Some technologies may be considered as unproven or unconventional and will probably require greater effort to obtain permits for their use, whether it is for pilot or full-scale projects. This criterion will attempt to quantify the number of permits and time required to obtain them. This approach implies that the larger number of permits will require proportionally more time to obtain, and that unconventional technologies will also require more time to permit, than a conventional technology.

### Performance Criterion: Minimize Legal and Regulatory Requirements

This criterion considers those legal issues associated with implementation of the technology. it is meant to assess the time required to acquire property, settle property disputes, adjudicate legal challenges, and ability to permit the technology. Some technologies may be considered as unproven or unconventional and will probably require greater effort to obtain permits for their use, whether it is for pilot or full-scale projects. This criterion will attempt to assess the number of permits and time required to obtain them. This approach implies that the larger number of permits will require proportionally more time to obtain, and that unconventional technologies will also require more time to permit, than a conventional technology.

The criterion will be evaluated through the use of two subcriteria

- Minimize legal requirements
- Minimize Permitting requirements

**SUBCRITERION**
Minimize Legal Requirements

| | |
|---|---|
| Definition | Expected level of effort to implement alternative from legal perspective. |
| Performance Measure | Qualitative; relative difficulty in resolving legal issues in a timely manner. |
| Scale | 1 to 5; higher score means fewer legal problems |
| Assumptions | Professional judgement used to estimate relative difficulty. |
| Value Functions | Negative/linear |

**SUBCRITERION**
Minimize Regulatory (Permit) Requirements

| | |
|---|---|
| Definition | Expectation that an alternative will be permitted based on whether it is a conventional alternative or an unconventional alternative ,Whether side streams generated by the technology require permits, the number of regulatory agencies involved, and the time frame for permitting. |
| Performance Measure | Qualitative; Number and complexity of permits required to implement alternative |
| Scale | 1 to 5; higher score means higher expectation of obtaining permits (if needed) in a timely manner |
| Assumptions | Professional judgement will be used to estimate the number and complexity of permits required for each alternative. The actual number of permits needed may vary from the number assumed in this analysis. |
| Value Functions | Positive/linear |

### Performance Criterion: Maximize Dairy Farmer Acceptance

Key to the ease with which any technology may be implemented is how readily the individual dairy farmer accepts it. This will be a qualitative assessment of the perceived effects of a particular technology on property values, production costs, taxes, and nuisance issues. Obviously, those technologies that minimize production costs, are easier to operate and maintain, and have the least negative impact on existing operations will typically be favored by the dairy industry. An essential subcriterion for farmer acceptance is the dairyman's familiarity farmer with the technology, and thus the already existing level of acceptance for the technology.

**PERFORMANCE CRITERION**
Maximize Dairy Farmer Acceptance

| | |
|---|---|
| Definition | The expected level of dairy farmer acceptance of perceived effects on property values, production costs, taxes or rates, quality of life, and nuisance issues, such as odor, aesthetics, noise, and other risks. |
| Performance Measure | Qualitative; Level of dairy farmer acceptance. |
| Scale | 1 to 5; higher score means increased levels of acceptance |
| Assumptions | Acceptance will be lower for more complex, expensive technologies. |
| Value Functions | Positive/linear |

## Objective 5: Minimize Environmental and Socio-Economic Impacts

Improving the water quality in Lake Okeechobee is critical to a healthy and sustainable economy and quality of life in the Okeechobee region. Because of this, the selection of dairy BATs should consider potential impacts to the region's environmental resources as a result of construction-related and operational activities. Technologies that also help to minimize adverse economic impacts are preferable. Five performance criteria were developed to better define this objective and are discussed below:

- Minimize Impacts to the Environment
- Maximize External Funding Sources for Technology Implementation
- Minimize Adverse Economic Impact to Okeechobee Region
- Minimize Generation of Low Value Sidestreams
- Maximize Benefits from Generation of High-value Sidestream

### Performance Criterion: Minimize Impacts to the Environment

**PERFORMANCE CRITERION**
Minimize Construction Impacts to the Environment

| | |
|---|---|
| Definition | The selection of appropriate technologies should consider potential impacts caused by construction and operation activities. |
| Performance Measure | Qualitative; Relative size of proposed facility and proximity, and potential for impacts, to environmentally sensitive areas and wetlands. |
| Scale | 1 to 5; "1" indicates a high probability of potential impacts to the environment. "5" indicates a low probability of potential impact to the environment. |
| Assumptions | A high probability of potential impacts to the environment is suspected if the proposed site for the technology is located on existing or other environmentally sensitive wetlands. A low probability of potential impact to the environment will be assumed if the proposed site is not located on existing wetlands or other environmentally sensitive areas. Intermediate scores indicate that the potential of construction-related impacts to existing wetlands from construction activities on sites adjacent to existing wetlands is not well defined. Professional judgement will form much of the basis of the values awarded to the several technologies. |
| Value Functions | Negative/Linear |

### Performance Criterion: Maximize External Funding Sources for Technology Implementation

External funding available for using a technology is an important component of a successful technology. Funding for construction or operation, either part or full, or in-kind service can be considered in this criterion.

**PERFORMANCE CRITERION**
Maximize External Funding Sources for Technology Implementation

| | |
|---|---|
| Definition | Compensation received from private (outside) sources to build or operate facilities. This could be a vendor, contract operations firms, etc. |
| Performance Measure | Quantitative; Value of compensation ($$) to be received on an annualized basis. |
| Scale | dollars |
| Assumptions | A higher funding level is preferred to a lower funding level. |
| Value Function | Positive/linear |

### Performance Criterion: Minimize Adverse Economic Impacts to Okeechobee Region

**PERFORMANCE CRITERION**
Minimize Adverse Economic Impacts to Okeechobee Region

| | |
|---|---|
| Definition | Qualitative assessment of each technology's potential affect on the dairy industry and related businesses if implemented. |
| Performance Measure | Qualitative; relative regional economic impact of technology |
| Scale | 1 to 5; higher score means less adverse regional economic impact |
| Assumptions | Professional judgement will be used to estimate the potential effect. |
| Value Functions | Negative/Linear. |

### Performance Criterion: Minimize Generation of Low Value Sidestreams

Some technologies will generate sidestream discharges of residuals, effluent, or some other material that must be handled and disposed or reused. This can increase the cost of a particular alternative. The project team will collect information on the frequency, size, and potential beneficial reuse of any sidestreams generated. The amounts and characteristics of the expected sidestream(s) will be used to numerically rank technologies.

**PERFORMANCE CRITERION**
Minimize Generation of Low Value Sidestreams

| | |
|---|---|
| Definition | Some technologies will generate sidestreams of residuals, effluent, or some other material that must be handled and disposed or reused. This can drive up the cost of a particular option. |
| Performance Measure | Quantitative; Annual volume of material (kg/cow) generated and strength of waste. |
| Scale | Kg/cow |
| Assumptions | None |
| Value Functions | Negative/linear |

### Performance Criterion: Maximize Generation of High Value Sidestreams

Some technologies may generate sidestreams that have some intrinsic value that could be used to offset the costs of handling and disposing of the material. Potential financial benefits will be used to numerically rank technologies.

**PERFORMANCE CRITERION**
Maximize Generation of High-Value Sidestreams

| | |
|---|---|
| Definition | Sidestreams from some technologies may have value |
| Performance Measure | Quantitative; Annual value of sidestream ($$/kg/cow) generated by a technology in dollars |
| Scale* | Dollars/ kg sidestream product / cow |
| Assumptions | None |
| Value Functions | Positive/linear |

## Criteria Weighting

Criteria weighting is the process by which the relative importance of each performance criterion is determined. The Value Model for the project can potentially have several levels of criteria, with criteria weights assigned to each level separately. Weights will be developed using the swing weighting technique, where participants (SFWMD, project team, TRT, other identified stakeholders) select the most important criteria within each level and then assign a ranked score of 100 to that criteria. Other criteria within the same level will then be judged relative to the most important criteria. For example, a ranked score of 90 to 99 for another criteria within the same level would signify that the criterion is nearly as important as the most important criterion, which was assigned a ranked score of 100. A ranked score of 50 would signify it is half as important as the most important criterion, and a ranked score of 1 to 10 would signify it is not nearly as important as the most important criterion. The ranked scores will then be normalized to calculate the relative weight of all criteria.

Each individual involved in the criteria weighting process will judge each criterion separately, and then the results of all the participants will be averaged. If there is wide disagreement on the criteria weighting results, team members will discuss and re-rank the criteria in an effort to build consensus among the group.

Exhibit 3 is an example of the first-level objectives that will be developed and ranked by the project team and stakeholders. The objectives are considered to be of primary importance in meeting the goal of this project.

**EXHIBIT 3**
First-Level Objective Weights to be Determined

| First-Level Objectives | Ranked Score | Relative Weight (%) |
|---|---|---|
| 1. Maximize Engineering Feasibility | | |
| 2. Maximize Cost-Effectiveness | | |
| 3. Maximize Water Quality Benefit | | |
| 4. Maximize Ease of Implementation | | |
| 5. Minimize Environmental and Socio-Economic Impacts | | |

As needed, each of the performance criteria can be (and in some cases already are) further defined by additional performance criteria and sub-criteria (termed second- and third-level criteria). Second- and third-level criteria are used to more precisely define the first-level criteria; however, not all first-level criteria need further definition. Exhibit 4 presents an initial list of performance criteria that will be ranked and weighted. The various subcriteria described above although not listed here, will also receive a weight within the first level criterion with which they are associated.

**EXHIBIT 4**
Summary of Second-Level Criteria Weights to be Determined

| Objectives (First Level) | Performance Criteria (Second Level) | Ranked Score | Relative Weight (%) |
|---|---|---|---|
| 1: Maximize Engineering Feasibility | Maximize Scalability | | |
| | Maximize Operational Reliability / Flexibility | | |
| | Minimize Potential Impacts of Natural Disasters | | |
| 2: Maximize Cost Effectiveness | Minimize Capital Costs | | |
| | Minimize O&M Costs | | |
| 3: Maximize Water Quality Benefit | Maximize P Concentration Reduction | | |
| | Maximize P Load Reduction | | |
| | Maximize Compliance with TP target concentration (40 PPB) | | |
| | Maximize Compliance with Numeric Class III Water Quality Standards. | | |
| 4: Maximize Ease of Implementation | Minimize Construction Time | | |
| | Minimize Training and Startup Time | | |
| | Minimize Legal and Regulatory Requirements | | |
| | Maximize Dairy Farmer Acceptance | | |
| 5: Minimize Socio-Economic Impacts | Minimize Impacts to the Environment | | |
| | Maximize External Funding for Technology Implementation | | |
| | Minimized Economic Impact to the Okeechobee Region | | |
| | Minimize Generation of Low Value Sidestreams | | |
| | Maximize Generation of High-Value Sidestreams | | |

# APPENDIX A

## Selection Methodology for Dairy Participation in the Project

The water quality data and surveys of the existing conditions and management practices for dairies in the Okeechobee basin will be reviewed to determine which three dairies will be included in the project. From among the dairies willing to participate, the dairies with the highest P export and the absence of implemented technologies and greater access to dairy technology management expertise will receive the highest priority for selection. Commitment of dairy resources and funds to ensure successful implementation of the appropriate technologies will also be considered.

Determination of P export from dairies will be based on the District's dairy monitoring data for the period 1995 through 1999 in order to best represent current conditions, i.e. post Dairy Rule BMP implementation. The assumption that discharge P concentration times the contributing area will be representative of the relative P export from the dairies must be made because no flow data are available from the dairies to calculate P loads directly. Though individual discharge sites might be poorly represented by this assumption, on average this assumption should be a fairly valid if used for comparative purposes. The District's "Works of the District" GIS polygon coverage will be used to estimate contributing areas.

The current technologies and management diversity of the dairies will be determined by review of Department of Environmental Protection (DEP) permit information, and by interviews with the dairymen in the basin. DEP permit and District water quality data will be used to develop a preliminary ranking of dairies to prioritize the dairymen interview schedules. Sunshine State Milk Producers (SSMP) will assist in setting up interviews. The dairy interviews will also be used to introduce the dairymen to the three-party agreement that will be required for their participation in the project. The agreement discussion will likely indicate the dairymen's willingness to participate.

The weighted factors presented in Exhibit A1 will be used to rank the dairies for participation in the project. Each dairy will be scored from 1 to 10 for each factor. Ten (10) is the highest possible factor score and one (1) is the lowest. The final score for each dairy will be the sum of the weighted factor scores.

**EXHIBIT A1.**
Factors and factor weights for Dairy Selection

| | Participation | Relative P Load | Existing Technologies | Management Diversity | Committed Dairy Resources |
|---|---|---|---|---|---|
| Source | Interview | District Data | DEP & Interview | Interview | Interview |
| Weight (%) | Yes or No (make or break) | 50 | 15 | 10 | 25 |

## CRITERIA FOR SETTING WEIGHTING FACTOR FOR EACH CATEGORY

### Participation

Participation will be based on a direct dairyman response during an interview. Anything other than "we will not participate" will be considered a positive response and the dairy will be included in the ranking process.

### Relative P Load

Points for relative P load will be determined from the following table based on the dairy's last five-year average P concentration. A 5-year average of all monitoring sites associated with a dairy was calculated and used as the overall dairy's P concentration.

**EXHIBIT A2**
Scale for ranking P load from dairies

| P Concentration Range (PPB) | Factor Points (Weighting factor 50%) |
|---|---|
| >5000 | 10 |
| 4500 – 5000 | 9 |
| 4000 – 4500 | 8 |
| 3500 – 4000 | 7 |
| 3000 – 3500 | 6 |
| 2500 – 3000 | 5 |
| 2000 – 2500 | 4 |
| 1500 – 2000 | 3 |
| 1000 – 1500 | 2 |
| 500 – 1000 | 1 |
| < 500 | 0 |

### Existing Technologies

The level and sophistication of existing BMPs and technologies on the dairy will be determined by site visits and interviews with dairymen. The following table outlines the point schedule for this category.

**TABLE A3**
Scale for ranking current dairy technologies

| Existing Technologies | Factor Points (Weighting factor 15%) |
|---|---|
| No Technologies beyond minimum Dairy Rule design | 10 |
| Enhanced Dairy Rule Technologies (high HIA confinement | 7 |
| Technology(ies) that is sequestering or moving significant manure P offsite | 5 |
| Edge of farm treatment | 3 |
| Technology(ies) that is controlling 100% of manure P | 0 |

## Management Diversity

Management diversity refers to the breath and depth of management and technical skills available on a dairy to manage and operate various P abatement technologies. The following table outlines the point schedule for this category.

**TABLE A4**
Scale for ranking current dairy technical expertise

| Management Diversity | Factor Points (Weighting factor 15%) |
|---|---|
| Very High Diversity | 10 |
| High Diversity | 8 |
| Moderate Diversity | 5 |
| Low Diversity | 3 |

## Dairy’s Willingness to Commit Resource to Project

The willingness of dairies to commit resources to ensure the project’s success either through direct funding or in-kind expenditures is considered extremely important. This factor will be critical for Board approval for the final project. The following table outlines the point schedule for this category.

**TABLE A5**
Scale for Dairy Resource Commitment Willingness

| **Dairy’s Willingness to Commit Resource to Project** | **Factor Points (Weighting factor 25%)** |
|---|---|
| Very High Commitment | 10 |
| High Commitment | 8 |
| Moderate Commitment | 5 |
| Low Commitment | 3 |
| No Commitment | 0 |